REMARKS

The present inventions called for in amended Claims 4, 38 and 73 are a method of working a metal which comprises the following three steps (a) to (c) and the resultant product:

(a) locally reducing deformation resistance of a metal body extending in one direction by forming a low deformation resistance region crossing the metal body by heating the metal body at a heating location while cooling the metal body at two spaced cooling locations on both sides of the heating location;

(b) subjecting the low deformation resistance region to shear deformation by twisting, thereby making the microstructure of said metal body fine; and

(c) moving the metal body, which has been subjected to the heating and the shear deformation, in said one direction so as to quickly cool the low deformation resistance region at one of said two spaced cooling locations.

In the above-mentioned method of working a metal of the present invention, the heating step (a) is carried out for facilitating the formation of the low deformation resistance region, the twisting step (b) is carried out for forming a fine microstructure, and the quick cooling step (c) is carried out for performing quenching such that the metal body can maintain the fine microstructure obtained by the twisting step (b) by stopping the structure of the metal body from becoming coarse.

Further, according to the method of working a metal of the present invention, the above-mentioned steps (a) to (c) are carried out along with the movement of the metal body in one direction and, hence, it is possible to continuously apply the above-mentioned working for making the microstructure of the metal body fine.

Still further, according to the method of working a metal of the present invention, the cross-section of the metal body is hardly changed by the above-mentioned treatment so that it is possible to apply the treatment to the metal body plural times with twisting in the same rotational direction or in the reverse direction.

In the Advisory Action, the Examiner states "The twisting limitation has been addressed in the reference to Torizuka and was present in the claims filed 8-11-2008 that were finally rejected on 11-26-2008. Torizuka is a method of working a heated portion of a metal body to produce fine grains and includes twisting. Applicant has pointed out that Torizuka cools the worked portion of the body after anvil deformation but this is cooling of the entire body. Yamaguchi is a teaching reference that teaches spaced cooling means and a heating device between the cooling means with a work region being between the cooling regions. The combination of Torizuka in view of Yamaguchi yields cooling on either side of a worked region during working so as not have to heat and cool the whole body.

The combination is obvious as having focused heating and cooling areas and Yamaguchi in the examiner's opinion is not fundamentally different as argued by Applicant".

However, Torizuka and Yamaguchi neither disclose nor suggest the above-mentioned new technical feature of the present invention, that is, moving the metal body, which has been subject to the heating and the shear deformation, in said one direction so as to quickly cool the low deformation resistance region at one of said two spaced cooling locations.

Torizuka's disclosure is primarily a method of working a heated portion of a metal body wherein the metal body is fixedly supported and, hence, there is no idea therein of moving the metal body. The same goes for Yamaguchi. In Yamaguchi, a metal circular tube 1 is firmly held on a frame F. There is a description that the core 12, the heating device 13 and the cooling jackets 14, 15 are moved so that there may be relative movement between the heating device 13 and the metal circular tube 1. However, the cooling jackets 14, 15 are provided merely for adjusting the heating width of the heated portion of the tube 1 in Yamaguchi, and an object to be moved is not the tube 1. Accordingly, Yamaguchi completely fails to disclose the technical feature of the present invention that the metal body is moved in one direction so as to quickly cool and thereby quench the low deformation resistance region, which has been formed by heating and being

subjected to shear deformation by twisting, at one of said two spaced cooling locations.

Further, since the tube 1 is fixedly mounted in Yamaguchi, each time the working is finished, the tube 1 must be replaced with another tube and, at the same time, a length of the tube 1 which can be worked is extremely limited due to the nature of working, that is, upset forming. To the contrary, according to the present invention, since what is moved is the metal body and the heating unit and the cooling units which are fixed can continuously apply heating and cooling to the moving metal body, it is possible to realize the continuous working of the elongated metal body.

Still further, the metal circular tube of Yamaguchi has cross-sectional areas thereof largely changed by the treatment and, hence, in contrast with the present invention, it is impossible for Yamaguchi to apply the treatment to the metal body plural times as can be accomplished by plural twistings in the same rotational direction or in the reverse direction. Torizuka does not recognize these advantages of twisting provided by the present invention and one of ordinary skill in the art would not find the twisting aspect of the present invention to be obvious in view of Torizuka considering that in the single incidental sentence in which Torizuka mentions "twisting" Torizuka equates twisting with compression, shearing and elongation.

In view of the above, we believe that the present invention is clearly distinguished from Torizuka and Yamaguchi even when they are combined.

Respectfully submitted,

JORDAN AND HAMBURG LLP

By_____
C. Bruce Hamburg
Reg. No. 22,389
Attorney for Applicants

Jordan and Hamburg LLP
122 East 42nd Street
New York, New York 10168
(212) 986-2340